Maintenance Readiness
Critical Needs For Early and Long Lasting Returns

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Fluor Corporate Overview

One of the world's leading engineering, procurement, fabrication, and construction, maintenance, and project management companies.

Fluor Corporation has been serving clients in the oil, gas, petrochemical, mining, power, and infrastructure sectors for over 100 years.

RANKED #1

- Ranked #1 on *Fortune* 500 Industry: "Engineering, Construction" in 2013
- Ranked No. 1 in *Engineering News-Record (ENR)* magazine's 2013 Top 100 Design-Build Firms
- Ranked No. 1 in *Fortune*'s annual survey or World's Most Admired Companies in "Engineering, Construction" industry category 2013

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Global Snapshot

- 38,000 global employees
- 1,000+ projects around the world annually
- Offices in six continents

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Fluor Canada

- **Fluor in Canada specializes in the specification, design and construction of world-class facilities, including extensive modularization capabilities.**
- **Fluor has built its reputation based on reliability, on-time and on-budget delivery, safety leadership and adherence to the highest ethical standards.**

Fluor provides the full spectrum of life-cycle services to support our clients' capital investments.

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Fluor's Global Services Operations & Maintenance

- Largest in-plant provider of maintenance and technical services in North America
- 4,000 salaried and 12,000 craft/technical
- 150 global clients at 400+ plant sites
- Oil & Gas client examples:
  - Imperial Oil, Shell Canada, Suncor, Syncrude
  - ADNOC, BP, Chevron, CNRL
  - ConocoPhillips, ExxonMobil
  - Gasco, SABIC, Sasol

- Services
  - Reliability & Maintenance Technical Services
  - Mechanical Integrity Improvement
  - Operational Readiness & Start-up
  - Plant Engineering & Small Capital Projects
  - Asset Performance Improvement
  - Total Maintenance Outsourcing
  - Utilities Operations & Maintenance
  - Outage and Turnarounds
  - Production Support and Logistics
  - Supplemental Maintenance
  - Facilities Management

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New Facility Goals & Typical Challenges

- On-time launch to generate products/profits to fulfill business case;
  but lacked operational readiness plan, creates gaps, delays start-up
- Ensure competiveness and maximize return on capital investment;
  focused on Capex vs. Opex, excessive life cycle total cost of ownership
- Desire for top-quartile plant maintenance and asset reliability;
  but ineffective or failed to implement best practices before start-up
- Workforce is ready;
  but underestimated effort to create new work culture, labor posture, and the training program was late, ineffective
- Understand project risks;
  due to lack of mitigation plans, or poor execution
- Proven supply chain for new Suppliers of materials, spares, services;
  but was not prioritized early to support start-up schedule

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Maintenance & Reliability Challenges

Successful start-up of a new facility poses a variety of challenges related to maintenance and reliability including:

- Budgeting for spares, tools, and equipment
- Availability of materials, suppliers, and contractors
- Adequacy of equipment documentation
- Accuracy and cost effectiveness of reliability procedures
- Understanding of equipment specific issues
- Organization of shops, tool rooms, and stores
- Readiness of technicians, planners, and supervisors
- Usefulness of management and technical support systems

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When is the Right Time to Implement Maintenance Best Practices for New Assets?

- We need to be careful deciding when to start implementing reliability and maintenance best practices
- **The right time to trigger your action is when the project moves into the FEL-2 phase, and no later than EPC detail design.**
- What happens if you start late?

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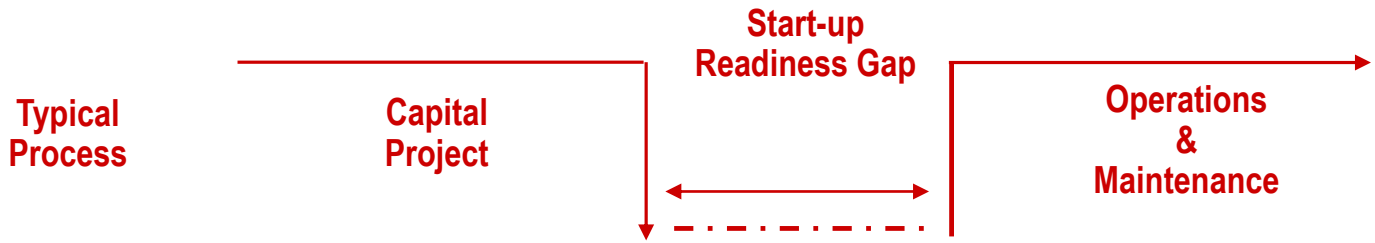
What If It's Too Late?
Importance of early O&M Involvement

- Often, the Maintenance scope/deliverables are not well planned or completed; causes a gap or time delay between the Capital Project and steady state Production



- Use of emerging strategies and best practices upfront can reduce or eliminate the gap, accelerate the startup and reduce risks.

Maintenance best practices must be in place before commissioning begins

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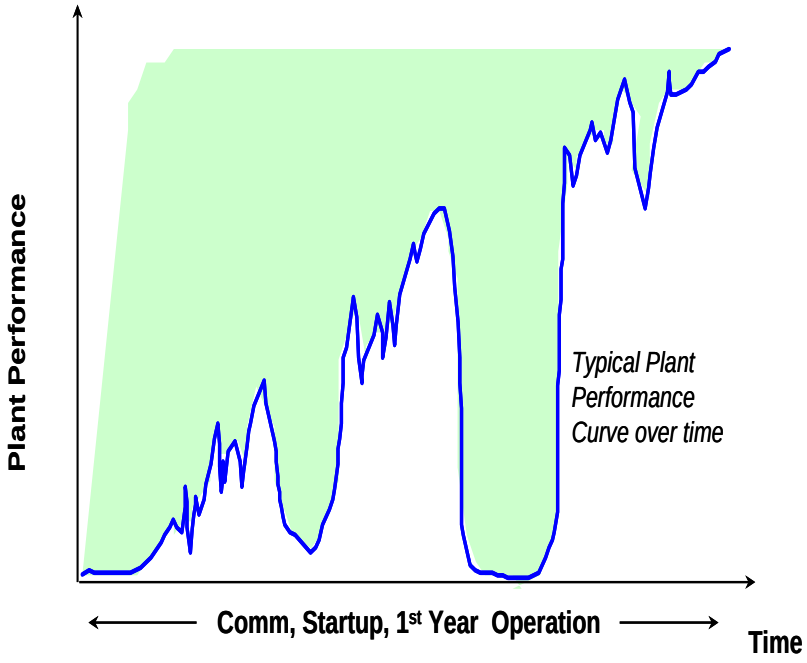
Why is this Important?

Plant Start-up Curve when Maintenance is *not Ready*



- Vendor data, documents are late
- People are not trained before start-up
- Spares are not all on site
- Maintenance job plans missing
- CMMS set is not done, ready, etc.
- Impacts plant start-up, reduces availability, and prolongs achieving the steady state production level
- Consequence is delayed start-up and reduced return on your capital

"Project success must focus on a new paradigm: a successful commercial operation is the objective, not mechanical completion."

Construction Industry Institute Report 121-1

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Emerging Strategies and Best Practices

- To address these demanding challenges, the most successful owners are assembling the pieces of the puzzle via integrated strategies
  - Integrating operational readiness best practices during the FEL phase
  - Concurrent design of new plant while completing O&M readiness tasks, deliverables, work processes, supply chains, and systems
  - Identifying, mitigating owner's risks and readiness gaps
  - Engagement of OEMs, EPC firms, and materials suppliers in contracts with broadened accountabilities including life cycle cost optimization
  - Planning/executing commissioning & startup with O&M directly involved
  - Creating Owner's operational readiness master plan

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Barriers to Best Practices
Conflicting Goals – Common Drivers

Owners	Investors	Customers	EPC Team	O&M Team
Main priority	**Main priority**	**Main priority**	**Main priority**	**Main priority**
▪ Return on Investment ▪ Financing ▪ Customers ▪ Government ▪ Business plan	▪ Investment risk ▪ Share price ▪ Schedule ▪ Revenue ▪ Production targets	▪ Reliable delivery of product ▪ Product quality ▪ Product price	▪ Project schedule ▪ Capital costs ▪ Technical performance ▪ Contracts ▪ Warranties	▪ Availability & reliability ▪ Uptime & OEE ▪ Opex costs ▪ Operability ▪ Maintainability ▪ Commissioning, start-up and ramp-up ▪ Plant business systems & processes

Best Practice

- *An Owner Sanctioned Integrated Project Approach*
  - *That Utilizes A Robust Process Upfront Including SMEs*
    - *To Understand & Address All Risks and Requirements*
      - *That Will Enable Owners To Meet All Business Goals*
        - *Applied Early In The Project With The EPC Team*

If Owners Don't Mandate This, Nobody Will

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UpFRONT[SM] O&M Readiness

A Fully Integrated Approach To Successful Commercial Operation

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O&M Readiness

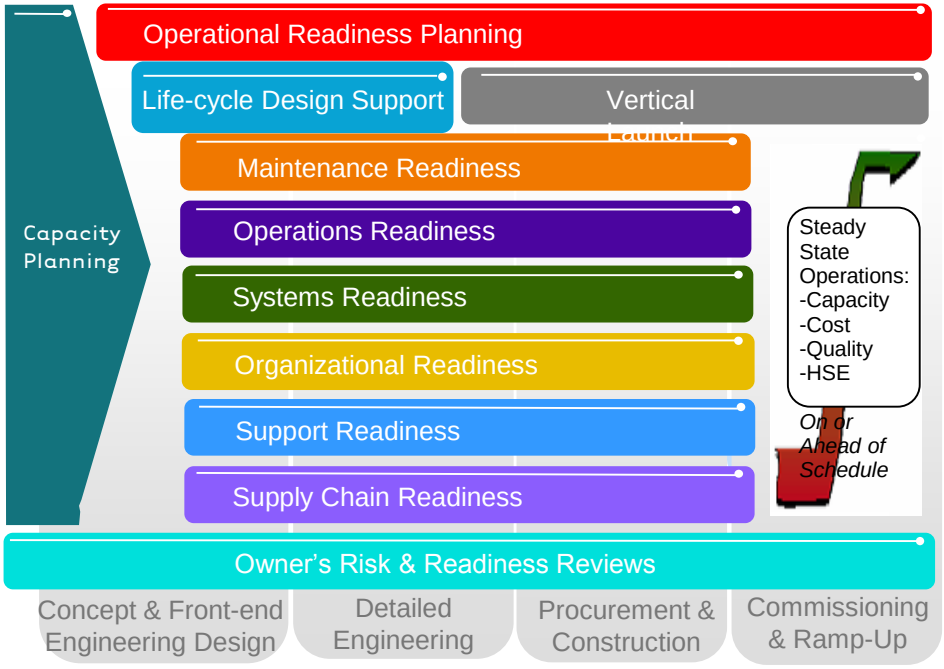
An UpFRONT℠ process that generates all of the required Operations & Maintenance Readiness deliverables

Operations Assurance Plan

O&M Philosophy
RAM Analysis, Initial RCM, Predictive Maintenance, Corrosion-Condition Monitoring,
Mechanical Handling Study and Plan, Portable Lifting Equipment, Standardization, Life Cycle Cost Analysis, Right First Time Readiness, Drafting and Tech Assistance,
Vendor O&M Document Data Specs, Human Factors Engineering, Operability, Maintainability Reviews, Equipment Sparing, Equipment Criticality Ranking

Construction Permits Procedure Operations Permits Procedure

CMMMS Population Plan Production Reporting System Integrated Data Warehouse, Handover



Asset Register, Lockout Tagout Program, R&R Procedures, Special Tools List, Spare Parts Stocking Guidelines, CMMS Data, Maintenance Manuals, O&M Org Chart and Manpower Projection, Multi-tasking Guidelines, Remaining RCM / PM / CM / RBI Program, Maintenance Job Plans, Function Testing, Third Party Assistance

Training Plan, Objectives, Procedures, Manuals, Classroom & OJT Based Training Courses, Competency & Effectiveness Evaluations

Spare Parts Data Procedure, Vendor SPIR Access & Training, SPIR Preparation, Validation, Submittal for 2-Year Operating Spares, Bulk Materials, Special Tools, Buy-Out Spares

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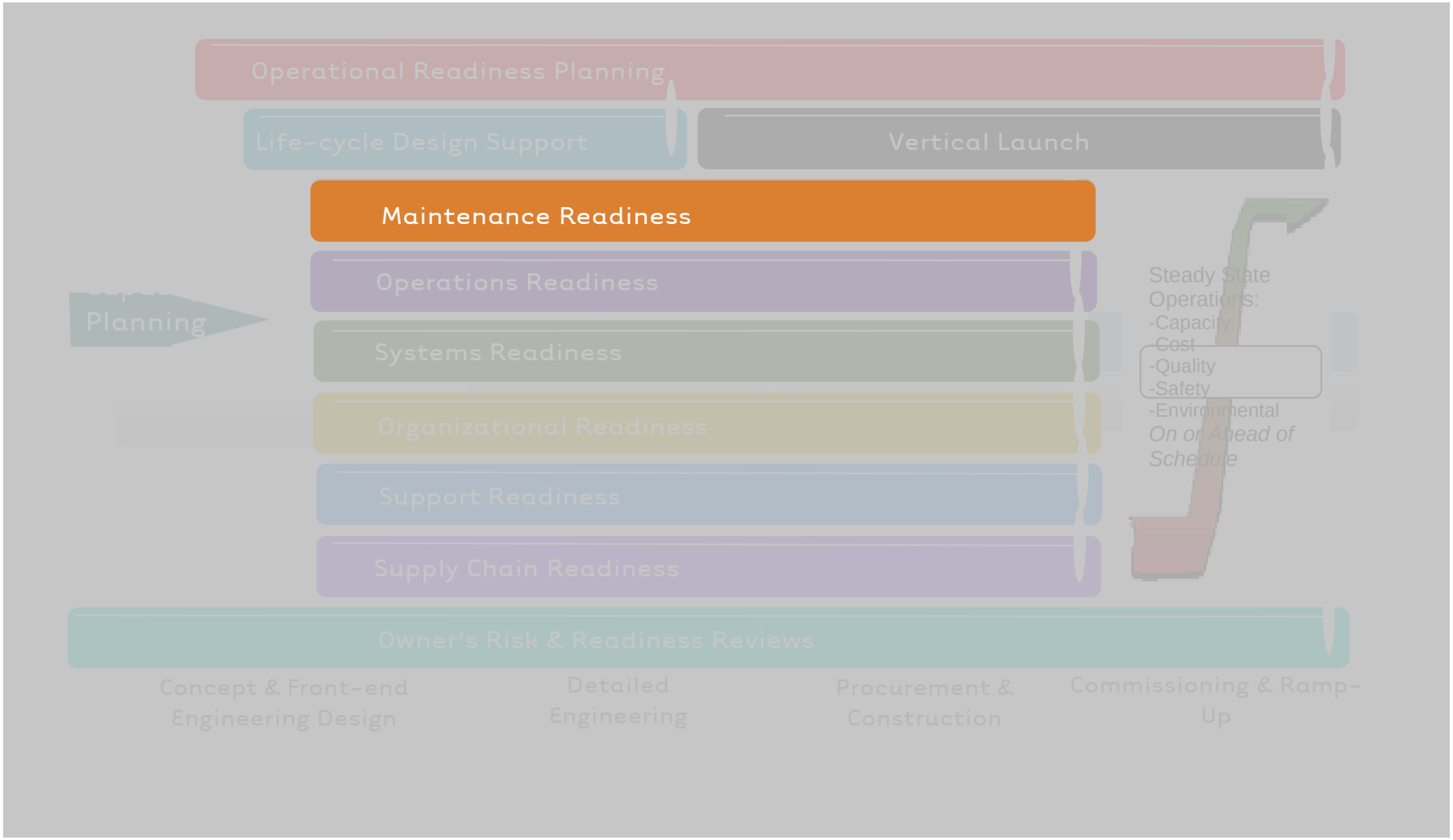
Emerging Strategies, Best Practices
Plant Maintenance + Asset Reliability



Maintenance Readiness Best Practices

Maintenance Readiness

- Develop/define maintenance strategy
- Provide input to equipment procurement specs
- Create asset register/functional location hierarchy
- Determine system and equipment criticality
- Process and component FMEAs
- Maintainability and operability reviews
- Develop PM/PdM program
- Develop reliability-based critical spare parts list
- Define shutdown maintenance requirements
- Develop repair and overhaul procedures
- Setting up condition monitoring equipment baselines

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Maintenance Readiness Best Practices

Maintenance Readiness

- Operational Readiness spec defining EPC requirements
- Documented O&M strategy and EPC contractor accountability
- O&M Data/Document Specifications for Equipment Suppliers
- Web-based portal to populate data, documents, critical information
- Handover Plan, work process and technology used to populate CMMS, CBM system, O&M Procedures, CBT Training, etc.
- Create asset register/functional location hierarchy specifications
- Determine system and equipment criticality levels
- Create Operability and Maintainability design guidelines, conduct O&M reviews during 3D model design reviews
- Initial high-level RCM analysis on critical equipment, maintenance strategies, 30-year life cycle cost for OPEX estimates

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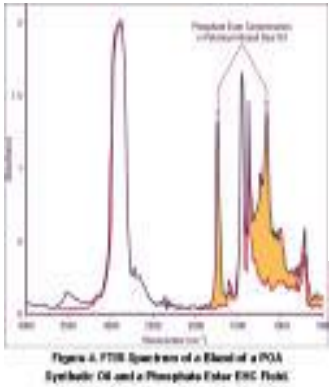
Maintenance Readiness Best Practices

Maintenance Readiness

Maintenance and reliability practices

- Asset management system databases
- Reliability Centered Maintenance (RCM)
  - Worksheets specifying required preventive maintenance, calibrations, nondestructive predictive maintenance, maintenance
- Life cycle budgets to execute maintenance programs specified via RCM
- Detailed maintenance staffing plans and schedules including ramp-up for commissioning
- Preventive, predictive, calibration and testing plans and procedures in asset management system



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Maintenance Readiness Best Practices

Maintenance Readiness

Maintenance and reliability practices

- Systematic failure elimination procedures and systems
- Predictive, calibration and testing baselines loaded in pre-initialized software systems to manage these activities
- Lubrication specifications, procedures and tools
- Repetitive job plans per results of RCM analyses
- Outage plans and management procedures for maintenance after start-up
- Operator performed maintenance checklists, diagrams, and procedures
- Troubleshooting procedures, databases, systems

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Maintenance Readiness Best Practices

Maintenance Readiness

Maintenance and reliability practices

- Gage and tool studies (ISO/QS/GGMP/PSM requirements)
- Routine and special tools, instruments and equipment with management procedures
- Economically optimized reorder points for MRO spares and commodities with inventory supply basis
- Maintenance control procedures with work flows, approvals, etc., loaded in asset management system
- Maintenance shop layout and equipment specifications
- Assessment and validation of post start-up effectiveness of maintenance programs

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Maintenance Readiness Benefits

- Best practices in place before start-up
- Shorter, safer, cheaper plant ramp-up; production levels achieved on schedule to meet business case
- Higher asset reliability and availability levels in first year after start-up which generates improved return on capital investment
- Increased plant maintenance technician and contractor productivity
- One half to one third less maintenance cost during the plant's first three years of operation
- Compliance with operating and environmental permit requirements
- Longer equipment life cycles and lower equipment life cycle costs
- More predictable plant throughput and customer deliveries

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The Results can be Great!

- Provide the foundation upfront for:
  - A high performance operation
  - Supported by a continuously innovating organization

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Thank you for your time.

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